Contents lists available at Curevita Journals

Curevita Research International Nexus

Impacts of Mining Activities on the Physicochemical Properties of Groundwater in Tirodi Region Balaghat District: A Comprehensive Review

Kuldeep Lakhera

Faculty of Botany, Veeranga Rani Durgawati Government College, Tirodi, MP, India.

Articleinfo

Article history: Received 2 May 2025, Revised 24 June 2025, Accepted 2025

Keywords: Mining activities, Groundwater, Physicochemical properties, Living beings, Environmental impacts.

Corresponding Author: Dr. Kuldeep Lakhera
Email ID:kuldeeplakhera89@gmail.com

Citation: Lakhera Kuldeep. 2025.Impacts of Mining Activities on the Physicochemical Properties of Groundwater in Tirodi Region Balaghat District: A Comprehensive Review.*Curevita Research International Nexus* .1,1, 35-41.

Publisher: Curevita Research Pvt Ltd

Abstract

Water is very necessary for the survival of all living beings on Earth. Hence, assessment of the quality and quantity of water is important at a certain time interval. The quality of water in mining areas is a most important issue of concern for our environment. This review paper explores the relationship between mining activities and the physicochemical properties of groundwater. The Mining operations have profound implications on the quality and availability of groundwater resources, disturbing parameters such as pH, metal concentrations, and overall water chemistry. The paper examines the diverse mechanisms through which mining activities alter groundwater characteristics, discusses associated environmental concerns, and evaluates potential mitigation strategies to safeguard this vital water source.

Introduction

Water is essential for all living things to sustain on earth; therefore, its quality and quantity examination are important at a certain time interval. Sharp changes have been found in demands for potable water due to surface water scarcity and the vast increase in population in many regions around the world. The importance of groundwater and the escalating impact of mining activities on its physicochemical properties. It emphasizes the need for a detailed analysis of how mining processes can induce changes in groundwater quality. The quality of groundwater is better in condition in Madhya Pradesh as compared to the other regions of India, but different reports show that water quality in many districts is being affected due to water-borne disorders (Chaterjee and Mohabey, 1998).

The quality of water in mines is a major issue of concern for our whole world. The impact of coal mining activities on the physicochemical properties of groundwater is substantial and can lead to significant alterations in water quality. The research work focused on quality assessment of coal mine water, based on water chemistry from different mines of the Sohagpur area, was done by Rathore and Singh (2021). The suitability of portable water of mine area pumped out from the Jharia coal field region of Dhanbad district of Jharkhand was studied by Baruah, P M and Singh, G in 2022. Yadav and Jamal (2018) assess the water quality of the coal mine areas partly situated in the Singrauli district of Madhya Pradesh and the Sonebhadra district of Uttar Pradesh. Based on their observation, they found that the water samples collected from different mining areas were not suitable for domestic and industrial purposes. The quality of surface and subsurface water was assessed by Yadav *et.al* in the northern coalfields limited area of Singrauli district, Madhya Pradesh, based on the water quality index (WQI) method. Based on their observation, they found that the water present in these area was not suitable for direct use. It should be utilized after the proper treatment.

The importance of groundwater and the escalating impact of mining activities on physicochemical properties. It emphasizes the need for a detailed analysis of how mining processes can affect groundwater quality.

Mining Processes and Groundwater Alterations: Various mining activities such as surface mining and underground mining, can involve heap leaching, which can induce specific effects on groundwater. Mechanisms such as acid mine drainage, leaching of heavy metals and subsidence-related impacts alter the physicochemical

properties of groundwater. Bagde (2016) assesses the impact of groundwater quality concerning Chhindwara District, Madhya Pradesh. Some physicochemical parameters of the Groundwater quality of the Pataleshwer in Chhindwara district was also assessed by Mahore in 2021. They were focused on assessing the quality of groundwater in the rural areas and its effect on the health of human beings. During the study they found high fluoride concentration in major part of Chhindwara district which shows that the majority of people are suffering from fluoride-related diseases that's why proper analysis and a water treatment management system were needed in that areas. Khatik, *et. al*., in 2012 and 2015 found a deteriorating condition of groundwater quality in Chhindwara due to an increase in fluoride (F) quantity released from granitic rocks. Gupta, *et.al*. (2018) prepared a review on the groundwater pollution in India and provided an overview of the groundwater pollution caused by anthropogenic activities as well as the industries. They were observed that the quality of water was affected by point and nonpoint sources such as runoff from the agricultural field, sewage discharge, urban runoff and industrial discharges. Therefore, proper analysis and assessment of the groundwater quality were needed for the ecosystem as well as human beings.

pH and Acidity Levels: Based on pH concentration, the groundwater samples were close to being neutral to alkaline in nature Dheeraj, *et.al* (2023). On exploring the impact of mining-induced processes on groundwater quality. Coal mining often exposes sulfur-bearing rocks, leading to the generation of AMD (Acid Mine Drainage**)**. This acidic drainage extensively lowers the pH of groundwater, causing it to become more acidic. The acidic conditions can mobilize heavy metals and cause risks to aquatic ecosystems. The release of acidic waters can produce effects in widespread environmental degradation and influence aquatic ecosystems in downstream.

Metal Contamination: Addressing the alteration of metal concentrations in groundwater due to mining activities, this section focuses on the leaching of heavy metals such as iron, copper, zinc, and mercury. Elevated metal concentrations pose threats to both human health and the ecological integrity of groundwater-dependent ecosystems. Coal seams often contain heavy metals like iron, manganese, and aluminum. Mining operations can expose these metals, allowing them to leach into groundwater. Elevated concentrations of heavy metals in groundwater can have detrimental effects on water quality and ecosystem health. The groundwater quality of the Korba coal field area of Chhattisgarh

was assessed by Dheeraj, *et. al* (2023) by using an integrated approach of geographical information system (GIS) and Heavy metal pollution index (HPI). They were observed that the groundwater of the studied area was contaminated by the leaching of heavy metals from the open pit mining and transit routes. It was found that the drinking water in the Korba Coal Field area is of good quality in terms of heavy metals, which gives a significant growth in socioeconomic activity in the study Korba region

Changes in Water Chemistry: Coal mining activities can result changes in water chemistry, the suspension of fine particles and sedimentation in nearby water bodies. Increased turbidity can adversely affect aquatic habitats, limiting light penetration and disrupting the balance of ecosystems. This section considers parameters like salinity, dissolved oxygen levels, and the presence of various ions. Mining processes can lead to substantial shifts in these properties, impacting the overall health and usability of groundwater. The release of ions and salts from coal mining processes can alter the chemical composition of groundwater. Changes in ion concentrations and increased salinity levels may render groundwater unsuitable for various uses, including drinking water and agriculture. Lalitha and Tejaswini (2017) assessed the quality of Groundwater of Vuyyuru situated in Krishna district of Andhra Pradesh and determined its suitability for drinking purposes. Their study covered physical-chemical and biological analysis of the water samples, and concluded that the quality of the Groundwater in most of the areas was not suitable for drinking purposes.

Physical Changes: Underground coal mining can cause ground subsidence, altering the physical structure of the ground. Changes in the structure may impact groundwater flow patterns, potentially affecting the movement and distribution of groundwater. The impact of coal mining activities on the groundwater quality of the Singrauli Coalfield region was assessed by Sonkar and Jamal (2018), and they observed that the quality of groundwater was more affected by coal mining activities as compared to the other one. The water in that area was not suitable for direct consumption. Disposal of coal dust and ash from mining activities can introduce particulate matter into the surrounding environment. These particles may contribute to the physical and chemical changes in groundwater, affecting water quality. Coal mining may release organic compounds into groundwater, contributing to organic contamination. This can have implications for both the quality of

groundwater and the health of ecosystems dependent on this water source.

Environmental Impacts and Ecosystem Consequences: Analyzing the broader environmental impacts of mining-induced changes in groundwater, this section explores how altered physicochemical properties can affect ecosystems, vegetation, and wildlife. It emphasizes the interconnectedness of groundwater systems with surface water and terrestrial environments. Cumulative impacts on groundwater quality can lead to long-term ecological consequences. Changes in water chemistry and habitat disruption may affect biodiversity, aquatic. The ecological status of coal mine area of Parasia was assessed by Kumara and Rathoureb in 2022. They were assessing the forest ecosystem near coal mine regions and anticipated the impacts of underground mining activity on the existing wildlife and ecology of the zone, along with mitigation measures presented. The mitigation and remediation measures addressed the adverse effects of mining activities on groundwater quality. Strategies may include proper waste management, engineered barriers, and the development of sustainable mining practices.

Conclusion

Groundwater was a major source of water quality for agriculture, industry as well as domestic purposes in most countries. Pollution of the groundwater quality will cause an impact on the human population, environmental conditions as well as industrial economics. The mining-related impacts on the quality of groundwater were causing a severe impact on the health and survival condition of human beings as well as the ecosystem surrounding in those areas. Therefore proactive and collaborative approach should be needed for sustainable mining practices. The major efforts taken for mitigating it were effective water management practices, adopting sustainable mining practices, developing new technologies for the treatment of contaminated water etc. The regular monitoring and widespread environmental impact assessments are essential for minimizing the adverse effects of mining activities on groundwater quality. Proper green belt development should be developed and maintained to negate the fugitive emissions from the bunker, loading, unloading, transportation, etc.

References

Bagde, N (2016). Groundwater quality assessment and its impact with special reference to Chhindwara District of Madhya Pradesh, India. *International Journal of Life Sciences*. Vol. 4(1): 116-120. ISSN: 2320-7817.

Baruah, P M and Singh, G (2022). Assessment of potability of minewater pumped out from Jharia Coalfield, India: an integrated approach using integrated water quality index, heavy metal pollution index, and multivariate statistics. *Environ Science Pollution Research*. Vol.29: 27366–27381.

Chaterjee M. K. and Mohabey N. K. (1998). Potential fluorosis problems around Chandidongri,Madhya Pradesh, India. Environ. Geochem.*Health*, Vol. 20: 1-4.

Dheeraj, V. P., Singh, C. S., Kishore, N and Sonkar, A. K (2023) Groundwater Quality Assessment in Korba Coalfield Region, India: An Integrated Approach of GIS and Heavy Metal Pollution Index (HPI) Model. *Nature Environment and Pollution Technology***.** Vol. 22(1): 369-382. P-ISSN: 0972-6268**.** DOI: 10.46488/NEPT.2023.v22i01.036.

Gupta, R., Srivastava, P., Khan, A. S. and Kanaujja, A (2018). Groundwater Pollution in India- A Review. *International Journal of Theoretical & Applied Sciences*. Vol. 10(1): 79-82. ISSN No. (Print): 0975-1718.

Khatik J. K. Kathal P. K. and Trivedi R. K. (2015). Quality of groundwater and fluoride contamination in the granitoids of Chhindwara District (M. P.), Central India, Editors, K. L. Shrivastava and P. K. Shrivastava, Scientific Blishers (India) 5 5 1 - 5 5 6 (I S B N -9788172339296).

Khatik J. K. Kathal P. K., and Trivedi R. K. (2012).Fluoride contamination in parts of the tribalbelts of Chhindwara district, Madhya Pradesh, India. *Bhu-Jal News*. Vol.27(1-4): 42-60.

Khatik, J., Kathal, P. K. and Ranjan, N (2022) Evaluation of Groundwater Quality Index (GwQI) of Groundwater inChhindwara District, Central India. *Asian Journal Experimental Science*. Vol. 36(1): 31-38. ISSN: 0971-5444.

Kumara, V and Rathoureb, A. K (2022) Ecological Status of Forest Ecosystem Near Underground Coal Mine in Parasia, Chhindwara, MP, India. *Octa Journal of Environmental Research*. Vol. 10(1): 011-033. ISSN 2321 3655.

Lalitha, B. V and Tejaswini, K, S (2017). A study on assessment of groundwater quality and its suitability for drinking in Vuyyuru, Krishna (dist.), Andhra Pradesh. *International Journal of Engineering Development and Research*. Volume 5(2): 1662–1668. ISSN: 2321-9939

Mahore, M. K (2021). Some Phisico-Chemical Assessment of Groundwater Sample at Pataleshwar Chhindwara. *International Journal of Advanced Research in Science, Communication and Technology (IJARSCT).* Volume 3(2): 59-61.ISSN (Online) 2581-9429. DOI: 10.48175/568.

Rathore and Singh (2021) Studied on the Hydrochemistry of Coal Mine of the Sohagpur area of the Shahdol District MP. *Bulletin of Pure & Applied Sciences***.** ISSN (P): 0970-4639**.**PP: 288-294.DOI: 10.5958/2320-3234.2021.00025.1.

Sonkar, A. K and Jamal, A (2018). Qualitative Assessment of Groundwater in Singrauli Coalfield Region, Madhya Pradesh. *Rasayan Journal Chem*. Vol. 11(3):1270-1276. ISSN: 0974-1496. http://dx.doi.org/10.31788/RJC.2018.1134026.

Yadav, H L. and Jamal, A. (2018). Assessment of water quality in coal mines: a quantitative approach. *RASĀYAN Journal of Chemistry (An International Journal of Chemical Sciences*). Vol.11 (1):46-52.

Yadav, H. L., Yadav, J., Jamal, A and Singh, D. K (2023). Assessment of surface and subsurface water quality of Northern Coalfields Limited, Singrauli, MP, Indiabased on water quality index method. *Eur. Chem. Bull*. Vol.12(4):1619-1627.